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(71) Applicant (*for all designated States except US*): ADVANCED COMMUNICATIONS CONSULTANCY (UK) LTD. [GB/GB]; 14 Sandringham House, Courtlands, Sheen Road, Richmond, Surrey TW10 5BG (GB).

(72) Inventor; and
(75) Inventor/Applicant (*for US only*): SFANDIARI, Hossein [IR/GB]; 20 Ellesmere Road, Eccles, Manchester M30 9FD (GB).

(74) Agents: HACKNEY, Nigel, J. et al.; Mewburn Ellis, York House, 23 Kingsway, London WC2B 6HP (GB).

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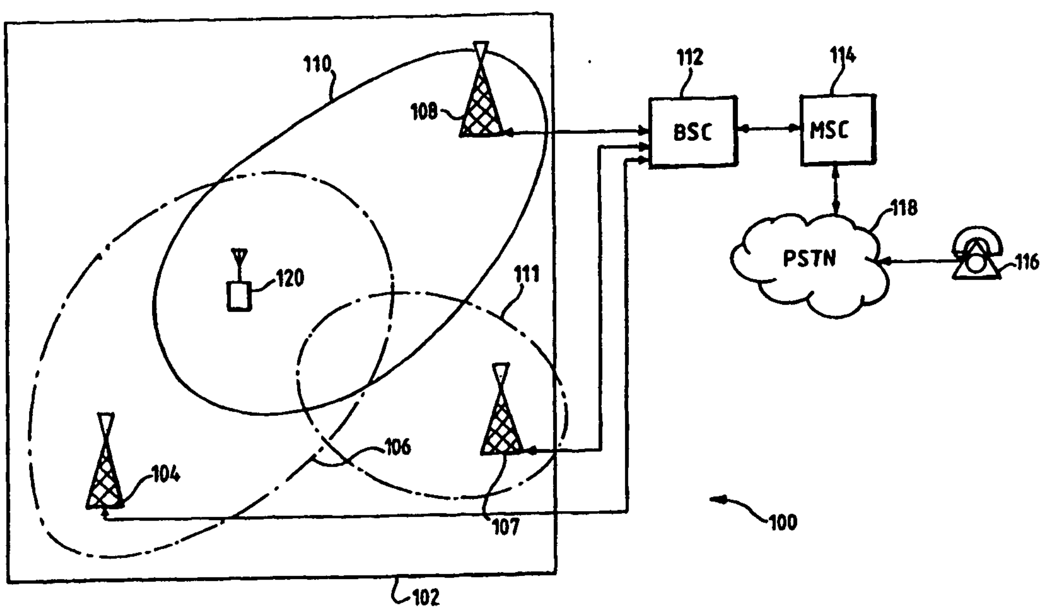

(57) Abstract

The present invention provides a method of detection of signals in a communication network (100) (e.g. cellular) including a mobile terminal (120), at least one first base station (104) serving the mobile terminal (120) and at least one second base station (108) wherein the method includes mobile transmitted data detected at the first base station being used by the second base station to increase detection of the transmitted data by the second base station.

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APPARATUS AND METHOD FOR SIGNAL DETECTION BY BASE STATION IN A MOBILE COMMUNICATION SYSTEM

The present invention relates to method and apparatus for detection of signals, particularly in a cellular communications network requiring location information and fast hand-off operation.

In cellular communications networks such as IS95, a mobile terminal in communication with a base station enjoys closed and open loop transmit power control. This effectively means that the mobile terminal transmission powers are optimised such that, at the servicing base station, the received signal levels are at a substantially constant minimum level for adequate detection, set by the desired quality of the communications link. If the mobile terminal is in communication with more than one serving base station, e.g. during soft hand-off period, the combined power or the strongest received signal (or a combination of the above two techniques) is kept to a substantially constant minimum level of adequate detection set by the desired quality of the communications link. The power control mechanism ensures that the multiple access interference, caused by a mobile terminal, within or outside the cell covered by the serving base station is kept to a minimum.

Although power control is desirable and even essential

in systems such as direct sequence spread spectrum code division multiple access (DS-CDMA), it reduces the ability of base stations, not serving a given mobile terminal, to receive and detect the mobile terminal transmissions adequately and reliably. The reliable detection of mobile terminal transmissions by base stations other than the serving base stations is desirable for services such as "location" and for "hand off" operations. It is therefore desirable to increase the detection ability of non-serving base stations without any increase in mobile terminal transmission power, so that information such as propagation time delay (i.e. distance) and mobile terminal signal power strength are available with a received signal well below the minimum required level for adequate information data detection.

The present invention sets out preferably to increase the detection ability of a mobile terminal transmitted signal by a cellular communications network, or signal transmitted by a first and second base stations and detected by a mobile terminal.

According, a first aspect of the present invention provides a method of detection of signals in a communication network (e.g. cellular) including a mobile terminal, at least one first base station serving the mobile terminal and at least one second base station wherein the method includes mobile transmitted data detected at the first base station

being used by the second base station to increase detection of the transmitted data by the second base station.

Preferably, the signal received by the first base station is of sufficient quality to enable detection of the data transmitted by the signal. More preferably the detected data is used by the second base station(s), where the mobile terminal transmissions are not received with sufficient power for adequate detection, to enable detection of the data by the second base station(s).

The detection process of the second base station(s) may be based on serial correlation, matched filter correlation, maximum likelihood sequence estimation, joint-detection or multiuser detection or any combination of these.

The detection process at the second base station(s) preferably includes detection of the presence of the data detected at the first base station(s).

The detection process at the second base station(s) preferably includes detection and calculation of the received time delay caused by signal propagation due to the distance of the mobile terminal from the respective base station.

The detection process at the second base station(s) may

additionally or alternatively include detection of the received signal power of the mobile terminal transmission signal by the second base station(s).

Preferably the mobile terminal is served by the first base station over a communications channel. More preferably, the communications channel is a traffic channel, an access channel or a control channel, which can be operated in a packet or circuit switched mode.

The cellular communications network is preferably a direct sequence spread spectrum code division multiple access (DS-CDMA) system and the data is preferably used to extend and increase the processing gain of the receiver by enabling longer integration times at the base stations. More preferably the network system is a GSM or GSM derivative system.

The location of the mobile terminal may be determined from the network system by e.g. using the received time delay at each respective base station, using the direction of the mobile terminal from each respective base station, or a combination of received time delay and/or direction of the mobile terminal from a first base station(s) and received time delay and/or direction of the mobile terminal from a second base station(s).

The process of determining the location of the mobile terminal using three or more fixed base stations of

known position is known in the art as triangulation or trilatituration.

Preferably, the data received by at least the first base station is capable of identifying the mobile terminal in the network system.

The measured signal power of the mobile terminal may be used for hand-off preparation from a first base station to a second base station.

Preferably the data transmitted by the mobile terminal is unknown information data.

Alternatively, or additionally, preferably the data transmitted by the mobile terminal is a predefined sequence.

The data received by the first base station may be used by that station as well as or instead of the second base station to improve detection of the transmitted data by the mobile station.

Preferably, Spatial filtering is used at the second base station(s) to reduce the effect of the propagation channel(s) on the received signal.

A second aspect of the invention provides a system for detection of signals in a communications network (e.g. cellular) including a plurality of base stations and a

mobile terminal wherein at a given time at least one of the base stations is a serving base station and the mobile terminal is served by the serving base station; the serving base station is capable of receiving and detecting data transmitted to it by the mobile terminal and the detected data is usable by the serving base station and/or at least one other base station to increase detection of the transmitted data.

An embodiment of the present invention will now be described by way of example only referring to the accompanying drawings in which:

Figure 1 is a schematic drawing of a general embodiment of the invention.

Figure 2 is a schematic drawing showing the components of part of a first base station of an embodiment of the invention.

Figure 3 is a schematic drawing showing the components of part of a second base station of an embodiment of the invention.

Figure 4 is a graphical representation of a data frame structure typically transmitted by the first and second base stations.

Figure 5 is a schematic drawing showing the components of a scrambler for scrambling and spreading the data

frame shown in Figure 4.

Figure 6 is a graphical representation of a data frame structure typically transmitted by the mobile terminal.

Figure 7 is a schematic drawing showing the components of a scrambler for scrambling and spreading the data frame shown in Figure 6.

Figure 8 is a flow diagram showing the operative steps of the part of the first base station shown schematically in Figure 2.

Figure 9 is a flow diagram showing the operative steps of the part of the second base station shown schematically in Figure 3.

A cellular system 100 (Fig. 1) installed in a geographical area, for example, a city centre 102 comprises a first base station 104 having a first associated coverage area 106 and a second base station 108 having a second associated coverage area 110, and a third base station 107 and associated coverage area 111.

The first, the second and the third base stations 104, 108, 107 are independently connected to a base station controller (BSC) 112, the BSC 112 being connected to a mobile switching centre (MSC) 114. The MSC 114 is in communication with a fixed terminal 116 via a public

switched telecommunication network (PSTN) 118.

An example of the first, the second and the third base stations 104, 108,107 are units of Supercell (trade mark) base stations manufactured by Motorola. The Supercell base stations have appropriate hardware and/or software modifications so as to be capable of functioning with time delay estimation units 220, 320. A mobile terminal 120 is located within the first coverage area 106 and the second coverage area 110. However, it is not essential for the mobile terminal 120 to be located within the second coverage area 110. The mobile terminal 120 can be located in the vicinity of the second and third coverage areas 110,111.

As example of the mobile terminal 120, is a Qualconn QCP/820 model cellular telephone.

Referring to Fig. 2, the first base station 104 comprises a receiver chain 200. The receiver chain 200 has an antenna 202 coupled to a low noise amplifier 204. The low noise amplifier 204 being coupled to a bandpass filter 206. The bandpass filter 206 is coupled to a mixer 208. The mixer 208 being coupled to a lowpass filter 212 and a synthesiser unit 210. The lowpass filter 212 is coupled to an analogue to digital converter (ADC) 214 which is coupled to a digital signal processor (DSP) 218 via a buffer 216.

The buffer 216 is also coupled to delay estimation unit

220. The delay estimation unit 220 is also coupled to the DSP 218. Within the delay estimation unit 220, the buffer output is coupled to a multiplier 222. The multiplier 222 is coupled to an integrator 224 and a variable delay unit 226. The integrator unit 224 is coupled to a peak detector 230, and is to integrate received data over a transmitted symbol period Ts, which is set to an initial value of zero at the beginning of each correlation operation i.e. starting at the beginning of each received data symbol. The output of the peak detector 230 is coupled to processor 232. The variable delay unit 226 is coupled to both processor 232 and the code unit 228. Finally, the clock 234 is coupled to processor unit 232. The clock 234 is also coupled to code unit 228.

The receiver is operating with both in phase and quadrature phase components present (i.e. complex data).

The above described receiver chain 200 is shown for exemplary purposes only and can also form a part of a transceiver circuit (not shown).

Referring to Fig. 3., the second and third base stations 108, 107 each include a receiver chain 300. The receiver chain 300 has an antenna 302 coupled to a low noise amplifier 304. The low noise amplifier 304 being coupled to a bandpass filter 306. The bandpass filter 306 is coupled to a mixer 308. The mixer 308

being coupled to a lowpass filter 312 and a synthesiser unit 310. The lowpass filter 312 is coupled to an analogue to digital converter (ADC) 314 which is coupled to a buffer 316. The buffer unit is coupled to a delay estimation unit 320. Within the delay estimation unit 320, the buffer output is coupled to a multiplier 322.

The multiplier 322 is coupled to an integrator 324 and a variable delay unit 326. The integrator unit 324 is also coupled to a peak detector 330. The integrator 324, having been set to an initial value of zero at the beginning of each correlation operation i.e. at the beginning of a received data block, is to integrate received data for a desired period Ti. The output of the peak detector 330 is coupled to a processor 332. The variable delay unit 326 is coupled to multiplier 329 and is also coupled to processor 332. A clock 334 is coupled to processor 332. The multiplier 329 is coupled to both a DSP unit 319 and a code unit 328. The DSP unit is coupled to information data unit 318. The clock 334 is also coupled to the code unit 328.

The receiver chain is operating with both in phase and quadrature phase components present (i.e. complex data).

The above described receiver chain 300 is shown for exemplary purposes only and can also form a part of a transceiver circuit (not shown).

The first, the second and the third base stations 104, 108, 107 are all capable of transmitting a sequence of 20 msec data frames having a data frame structure 400 (shown in Figure 4). The data frame 400 has a structure comprising information data portions 436, 438, 440, 442, 444, 446, 448, 450, 452, 454, 456, 458, 460, 462, 464, 466, 468. The frame structure 400 also comprises 16 power control data portions, 404, 406, 408, 410, 412, 414, 410, 418, 420, 422, 424, 426, 428, 430, 432, 434.

The data frame 400 is scrambled and spread by scrambler code 500. Spreading is, to broaden the signalling bandwidth of the data frame 400. The scrambler includes several codes 504, 506, 508, 510, known to all network components, ie. base stations 104, 108 and 107 and mobile terminal 120.

Referring to Fig. 5. The data is scrambled and spread by LC code 504, at multiplier 512. The data is further scrambled by Walsh code 506 at multiplier 514. The resulting scrambled data is then, once scrambled by I code 510 for in phase transmission at multiplier 516, and once by Q code 508 for quadrature phase transmission at multiplier 518. The resulting scrambled and spread codes are referred to, for this example, as scrambling code 502.

The scrambling code 502 is used for calculation of various parameters, for example channel estimation,

frame synchronisation and coherent detection of data. The mobile terminal 120 operations are synchronised to the scrambling code 502.

The mobile terminal 120 is capable of transmitting a sequence of 20 msec data frames having a data structure 600. The data frame 600 consists mostly of information data portion.

The data frame 600 is scrambled and spread by scrambler 700. Spreading is, to broaden the signalling bandwidth of the data frame 600. The scrambler 700, includes several codes 704, 712, 706 known to all network components, i.e. base stations 104 and 108 and mobile terminal 120.

Referring to Fig. 7. The data is scrambled and spread by LC code 704 at multiplier 710. The resulting scrambled and spread data is then once scrambled by I code 708 for in phase transmission, at multiplier 712, and once by Q code 706 for quadrature phase transmission at multiplier 714. The resulting scrambled and spread codes are referred to, for this example, as scrambling code 702.

The operation of the above cellular system 100 will now be described below.

A call is established according to any known method in the art. The first base station 104 being in

communication with the mobile terminal 120 and a first traffic channel (tch) is allocated. Data frames having the structure of the first data frame structure 400 are transmitted from first base station 104 and received by mobile terminal 120. Data frames having the structure of the second data frame structure 600 are transmitted from mobile terminal 120 and received by first base station 104. The first base station 104 by means of power control data 404, 406, 408, 410, 412, 414, 416, 418, 420, 422, 424, 426, 428, 430, 432, 434 controls the transmit power of the mobile terminal 120 according to techniques well known technique in the art. The data frames 600 received by the first base station antenna 202 are of only sufficient power for correct detection of propagation time delay and information data by the first base station 104. By information data, it is meant the <u>unknown</u> information data which is present in the data frames 400 and data frames 600.

Hence the mobile terminal 120 transmit power, is of sufficient magnitude to overcome the propagation losses to the first base station 104 only. The second and the third base Stations 108, 107 not in communication within the mobile terminal 120 may suffer excessive propagation losses such that they are unable to receive the transmitted data frames 600 by the mobile terminal 120, with sufficient power for reliable and successful detection of time delay and information data.

A method of detection of information data 828 and time

delay 829 for the first base station 104 is outlined in Figure 8 and is as follows. The synthesiser 210 of the first base station 104 is tuned to receive a data frame 600 <u>at the expected time of arrival</u>, transmitted from the mobile terminal 120 (step 802). As traffic data frame 600 is received, in the specified time frame, by the first base station 104, the traffic data is stored (step 806).

The first base station 104 then determines (step 808) whether sufficient time has elapsed to receive the entire data frame 600. Considering the longest propagation time delay expected, due to distance between the first base station 104 and the mobile terminal 120. If sufficient time has not elapsed, the first base station 104 continues to receive and store the traffic data (step 806). When the specified time has elapsed, the first base station 104 initialises the expected time delay (T) to zero (step 810).

The descrambling code which is similar to scrambling code 702 at the time of transmission of the data frame 600 by the mobile terminal 120 (which is known in the art as code synchronised) is then delayed by the specified time delay T (step 812). The first base station 104 descrambles the received data traffic with the delayed descrambling code 702 (step 814). The descrambled data traffic is then summed (integrated) over a data symbol period Ts (step 818).

If no substantial peak is detected by the first base station 104, the expected time delay T is increased (by a set amount) (step 820) and the steps 812, 814, 816, 818 and 820 are repeated until a substantial peak is detected. After the detection of a substantial peak, the first base station 104, calculates and stores the time delay and further calculates the distance from the mobile terminal 120 (step 822).

In the presence of multipath propagation, several peaks may be detected, where one or more peaks can be used for data detection.

After the successful estimation of the time delay between the first base station 104 and the mobile terminal 120, the correct portion of the received traffic data is selected at the data frame portion 600, transmitted by the mobile terminal 120 (step 826), the information data contained in the data frame 600 is then detected and stored (step 428).

The time delay and the distance between the first base station 104 and the mobile terminal 120 are sent to MSC 114, and stored.

A method of detection of time delay for the second base station 108 is outlined in Figure 9 and is as follows.

The synthesiser 310 of the second base station 108 is tuned at the expected time of arrival of data frame 600

to receive the data frame 600, transmitted from the mobile terminal 120 (step 902). As traffic data is received, in the specified time, by the second base station 108, the traffic data is stored (step 906).

The second base station then determines (step 908) whether sufficient time has elapsed to receive the entire data frame 600, allowing for the longest expected propagation time delay caused by the distance between the second base station 108 and the mobile terminal 120. If sufficient time has not elapsed, the second base station 108 continues to receive and store the traffic data (step 906). When the specified time has elapsed, the second base station 108 obtains and stores information data 318 detected and stored at step 828, by the first base station 104, via network elements, e.g. BSC 112 (step 910).

The second base station 108 then processes 319 the stored information data 318 and scrambles it with scrambling code 702, 328 in a similar manner to the processing and scrambling performed by the mobile terminal 120 on the original information date, prior to transmission of data frame 600 and stores it (step 912). After step 912, the stored processed and scrambled information data, referred to now as "data descrambling code" is substantially similar in envelope and phase to the transmitted data frame 600 by the mobile terminal 120.

The second base station 108 then proceeds to initialise the expected time delay T to zero (step 916). The "data descrambling code" is then delayed by the specified delay T (step 918). The second base station 108 descrambles the received data traffic with the "data descrambling code" (step 920). The descrambled data traffic is then summed (integrated) over sufficient long time, Ti to ensure reliable and successful detection of mobile terminal 120 transmitted data frame 600 (step 922). Ti is long enough to provide enough processing gain to account for all possible excess propagation losses experienced by the second base station 108, compared to that experienced by the first base station 104.

The second base station 108 then determines whether a substantial peak is detected as a result of the summation (step 928). If no peak is detected by the second base station 108, the expected time delay T is increased (step 924), and the step 918, 920, 922, 926 and 924 are repeated until a substantial peak is detected. After the detection of an acceptable peak, the second base station 108 calculates and stores the time delay and further calculates the distance the mobile terminal 120 is from the second base station 108 (step 928).

The third base station 107 operates a method of detection of time delay substantially identical to that explained above for the second base station 108.

The time delay and distance between the second base station 108 and the mobile terminal 120 are sent to MSC 114 and stored. The time delay and distance between the third base station 107 and the mobile terminal 120 are sent to MSC 114 and stored. The MSC 114 uses, by a method known in the art as triangulation, the stored data on the distance of the mobile terminal 120 from the first and second and the third base stations 104, 108, 107 the known coordinates of the first, the second and the third base stations 104, 108, 107 to estimate the coordinates of the mobile terminal 120.

The remaining components of a cellular communication system base station are well known in the art and need not be described in detail herein.

The above embodiments of the present invention have been described by way of example only and various alternative features or modifications from what has been described can be made within the scope of the invention, as will be readily apparent to persons skilled in the art.

CLAIMS

1. A method of detection of signals in a communication network including a mobile terminal, at least one first base station serving the mobile terminal and at least one second base station wherein the method includes mobile transmitted data detected at the first base station being used by the second base station to increase detection of the transmitted data by the second base station.

2. A method according to claim 1 wherein the signal received by the first base station is of sufficient quality to enable detection of the data transmitted by the signal and the detected data is used by the second base station, where the mobile terminal transmissions are not received with sufficient power for adequate detection, to enable detection of the data by the second base station.

3. A method according to claim 1 or claim 2 wherein the detection process at the second base station(s) includes detection and calculation of the received time delay caused by signal propagation due to the distance of the mobile terminal from the respective base station.

4. A method according to any one of claims 1 - 3 wherein the detection process at the second base

station(s) includes detection of the received signal power of the mobile terminal transmission signal by the second base station.

5. A method according to any of claims 1 - 4 wherein the communications network is a cellular communications direct sequence spread spectrum code division multiple access (DS-CDMA) system and the data is used to extend and increase the processing gain of the receiver by enabling longer integration times at the base stations.

6. A method according to any one of claims 1 - 5 in which the location of the mobile terminal is determined from the network system by any one of some or all of:(a) using the received time delay at each respective base station, (b) using the direction of the mobile terminal from each respective base station and, (c) a combination of received time delay and/or direction of the mobile terminal from a first base station(s) and received time delay and/or direction of the mobile terminal from a second base station(s).

7. A method according to any one of claims 1 - 6 in which the data received by at least the first base station is capable of identifying the mobile terminal in the network system.

8. A method according to any one of claims 1 - 7 in which the measured signal power of the mobile terminal is used for hand-off preparation from a first base

station to a second base station.

9. A method according to any one of claims 1 - 8 in which the detection process at the second base station(s) includes detection of the presence of the data detected at the first base station(s).

10. A method according to any of claims 1 - 9 in which the data transmitted by the mobile terminal is unknown information data.

11. A method according to any of claims 1 - 9 in which the data transmitted by the mobile terminal is a predefined sequence.

12. A system for detection of signals in a communications network including a plurality of base stations and a mobile terminal wherein at a given time at least one of the base stations is a first serving base station and the mobile terminal is served by the first serving base station; the first serving base station is capable of receiving and detecting data transmitted to it by the mobile terminal and the detected data is usable by the first serving base station and/or at least one second base station to increase detection of the transmitted data.

13. A system according to claim 12 wherein the signal received by the first base station is of sufficient quality to enable detection of the data transmitted by

the signal and the second base station, where the mobile terminal transmissions are not received with sufficient power for adequate detection, includes means for using the detected data to enable detection of the data by the second base station.

14. A system according to claim 12 or 13 wherein the second base station includes means for detection and calculation of the received time delay caused by signal propagation due to the distance of the mobile terminal from the respective base station.

15. A system according to any one of claims 12 - 14 wherein the second base station includes means for detection of the received signal power of the mobile terminal transmission signal by the second base station.

16. A system according to any one of claims 12 - 15 wherein the communications network is a cellular communication direct sequence spread spectrum code division multiple access (DS-CDMA) system and it includes means for using the data to extend and increase the processing gain of the receiver by enabling longer integration times at the base stations.

17 A system according to any one of claims 12- 16 including means for the location of the mobile terminal to be determined from the network system by any one, some or all of :(a) using the received time delay at

each respective base station, (b) using the direction of the mobile terminal from each respective base station, and (c) a combination of received time delay and/or direction of the mobile terminal from a first base station(s) and received time delay and/or direction of the mobile terminal from a second base station(s).

18. A system according to claims 12- 17 including means for using the data received by at least the first base station to identify the mobile terminal in the network system.

19. A system according to claims 12- 18 including means for using the measured signal power of the mobile terminal for hand-off preparation from a first base station to a second base station.

20. A system according to any one of claims 12 - 19 in which the second base station(s) includes means for detection of the presence of the data detected at the first base station(s).

21. A method according to any of claims 12 - 20 in which the data transmitted by the mobile terminal is unknown information data.

22. A method according to any of claims 12 - 20 in which the data transmitted by the mobile terminal is a predefined sequence.

23. A method of detection of signals subsequently as any one embodiment herein described or referenced to the accompanying drawings.

24. A system for detection of signals subsequently as any one embodiment herein described or referenced to the accompanying drawings.

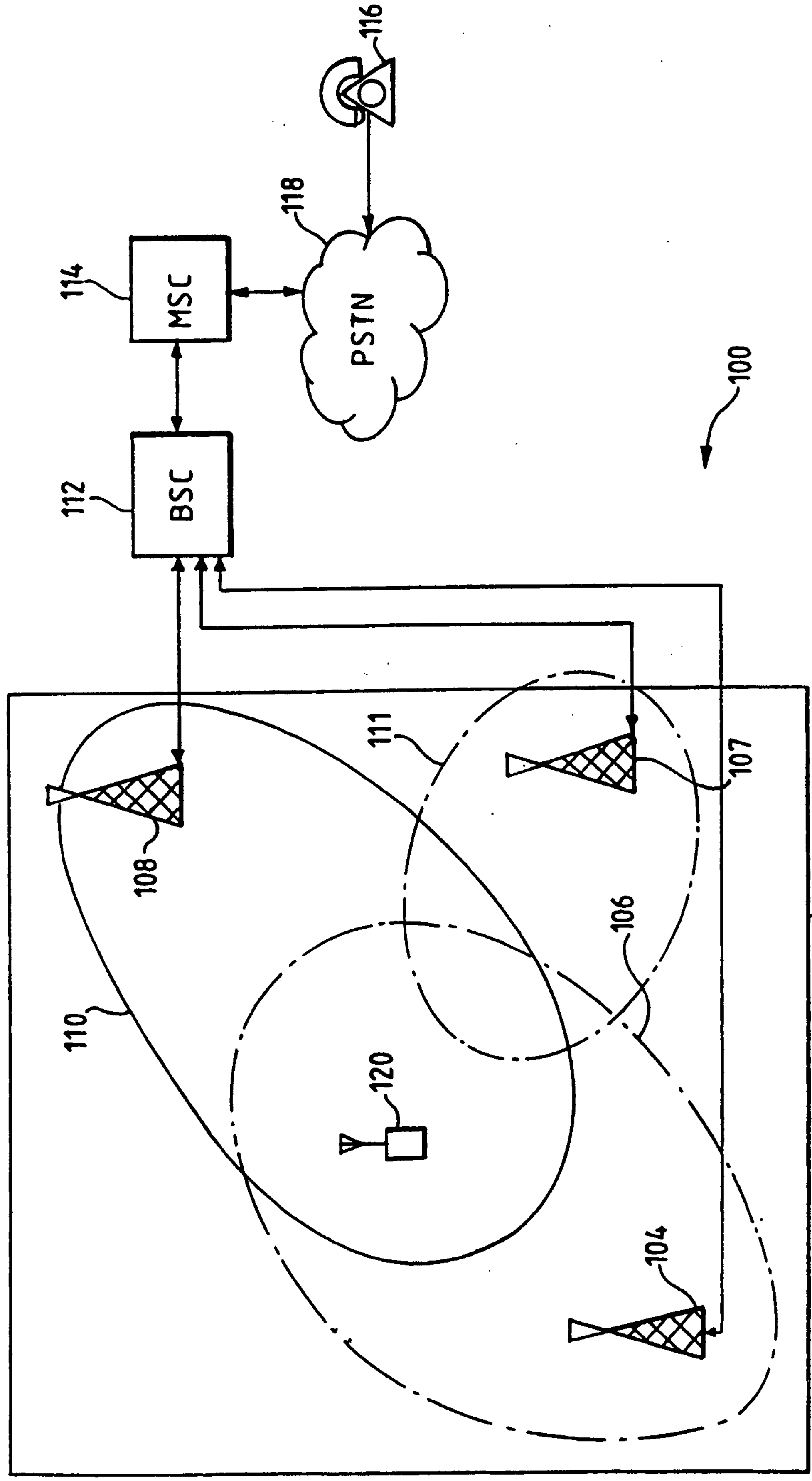

FIG.1.

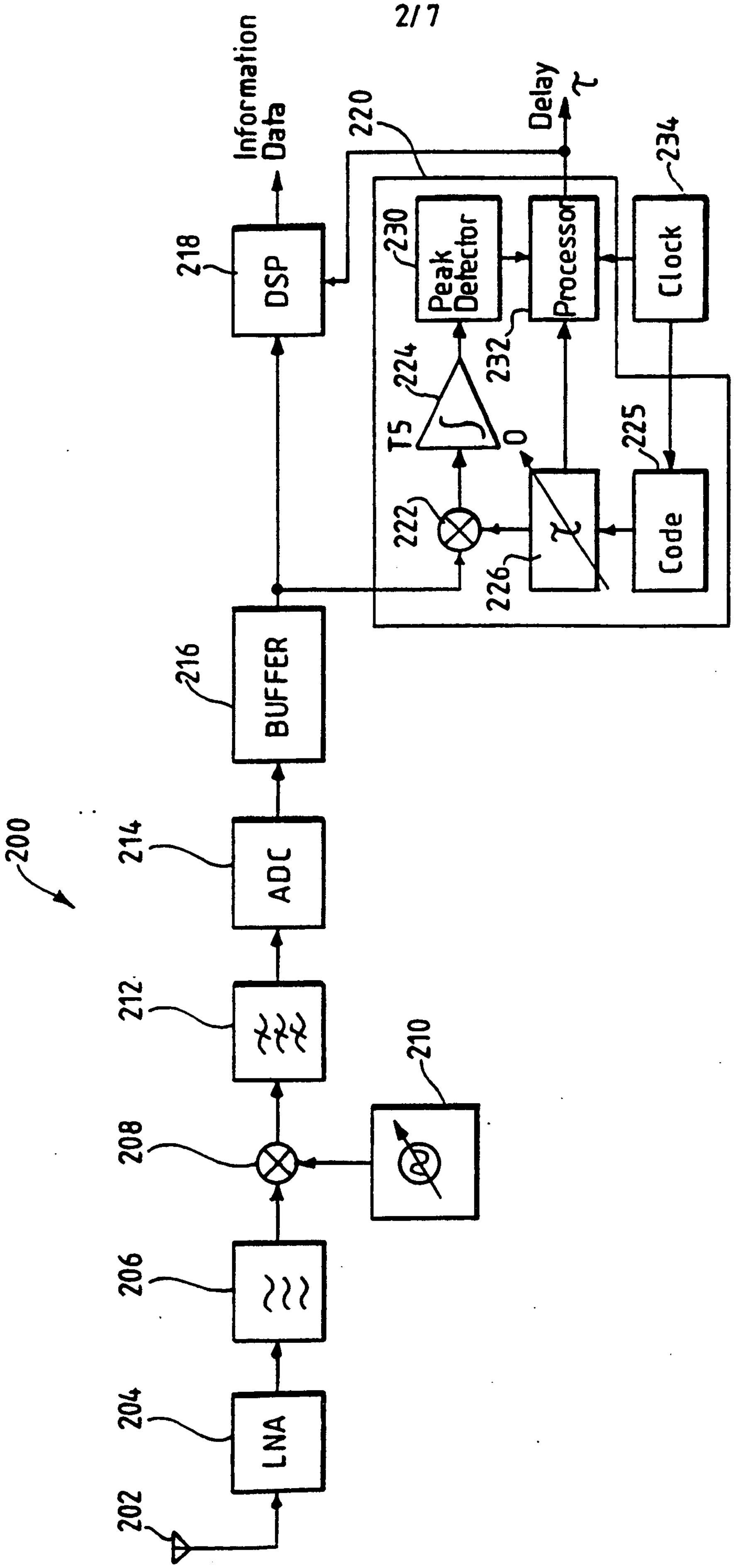
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FIG. 2.

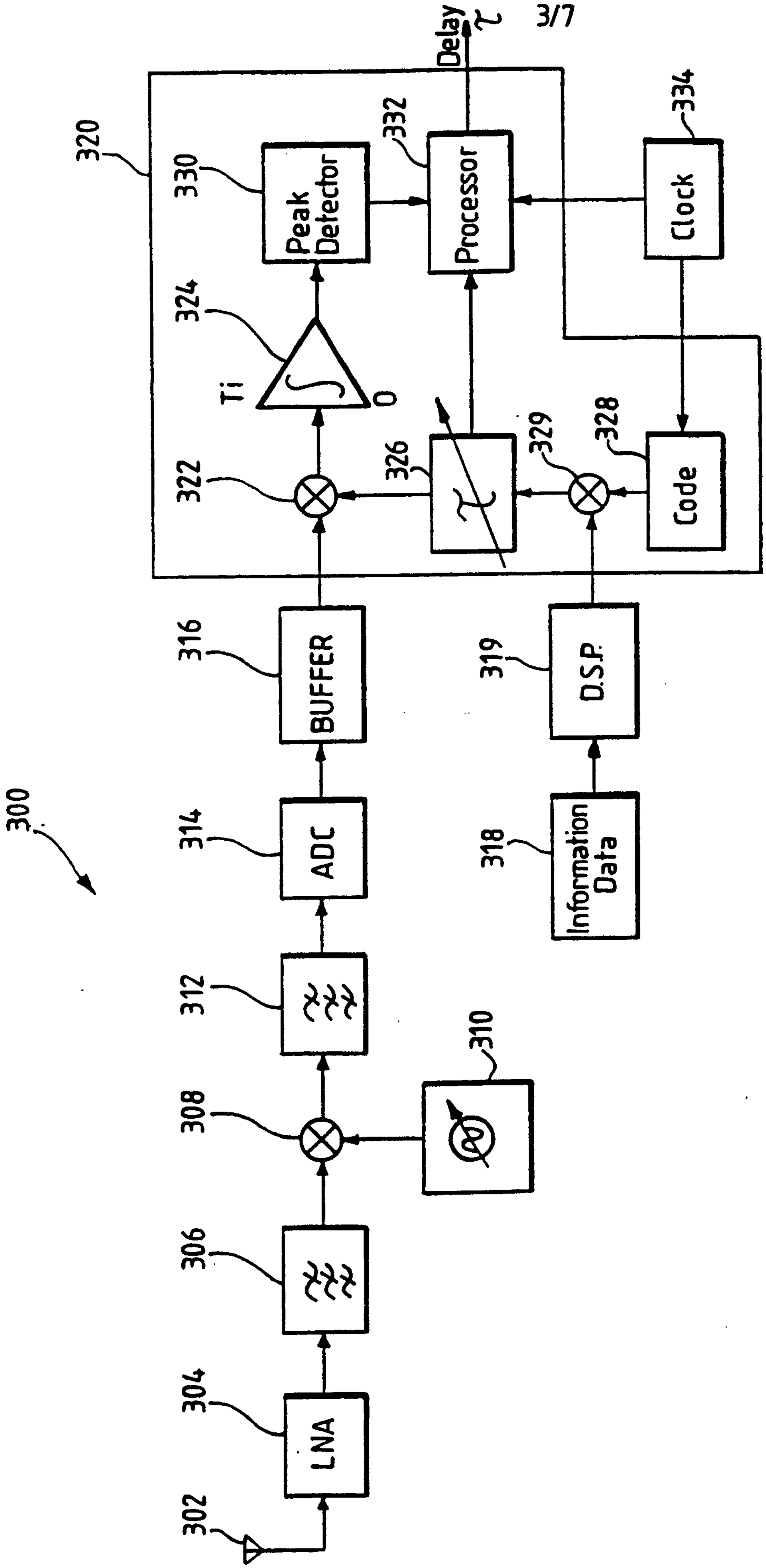
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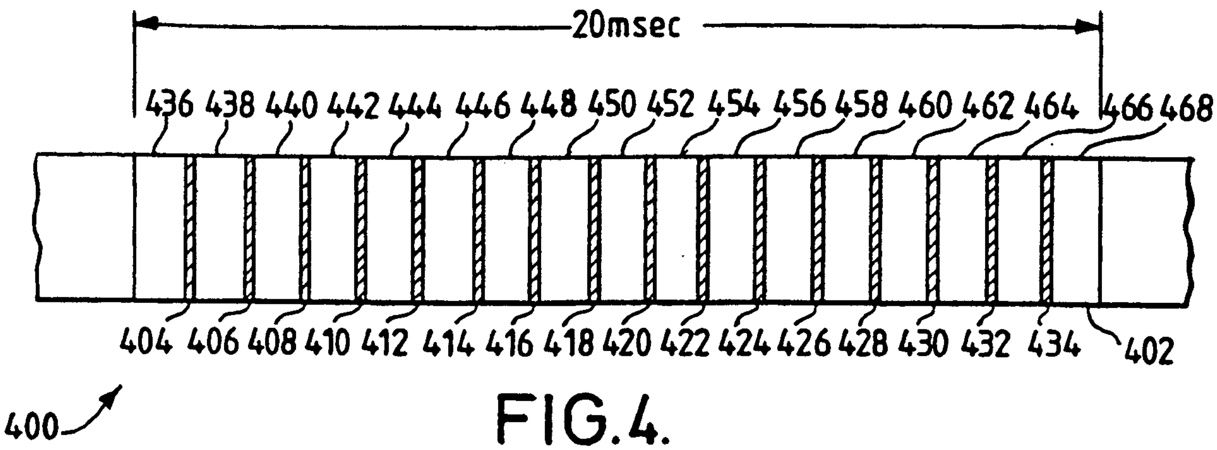
FIG.3.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400

FIG.4.

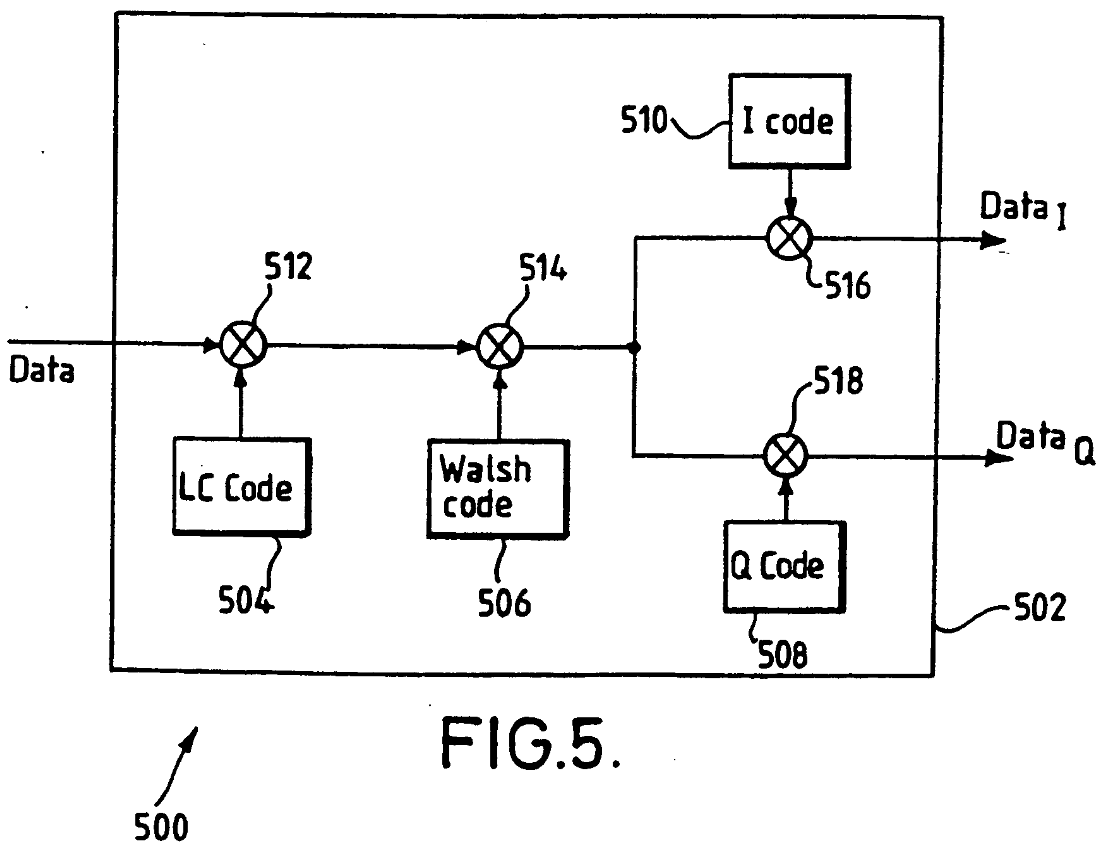
I code
510
Data I
512
514
516
Data
518
Data Q
LC Code
Walsh code
Q Code
504
506
502
508
500

FIG.5.

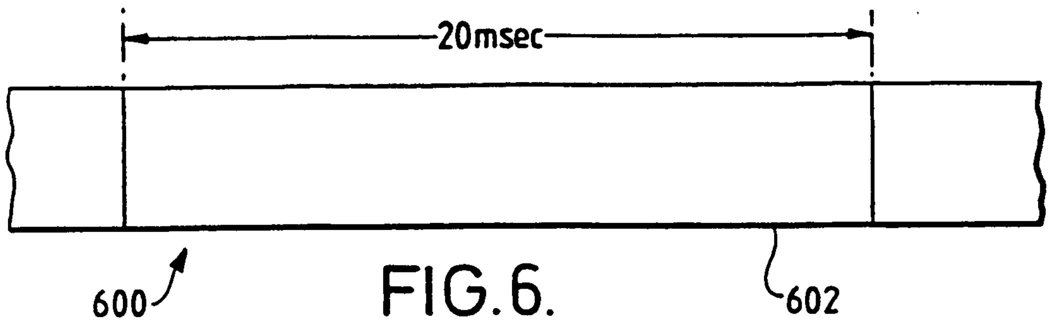
20msec
600
602

FIG.6.

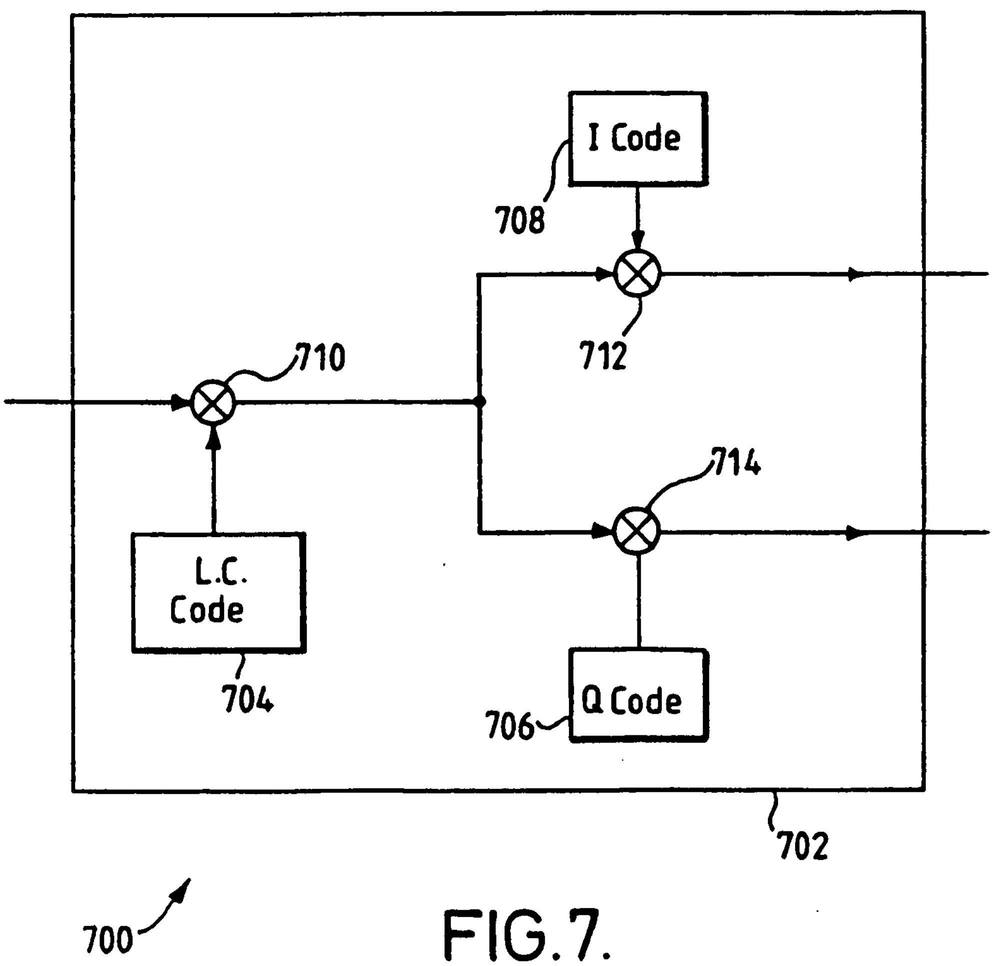
I Code
708
712
710
714
L.C. Code
704
Q Code
706
702
700

FIG.7.

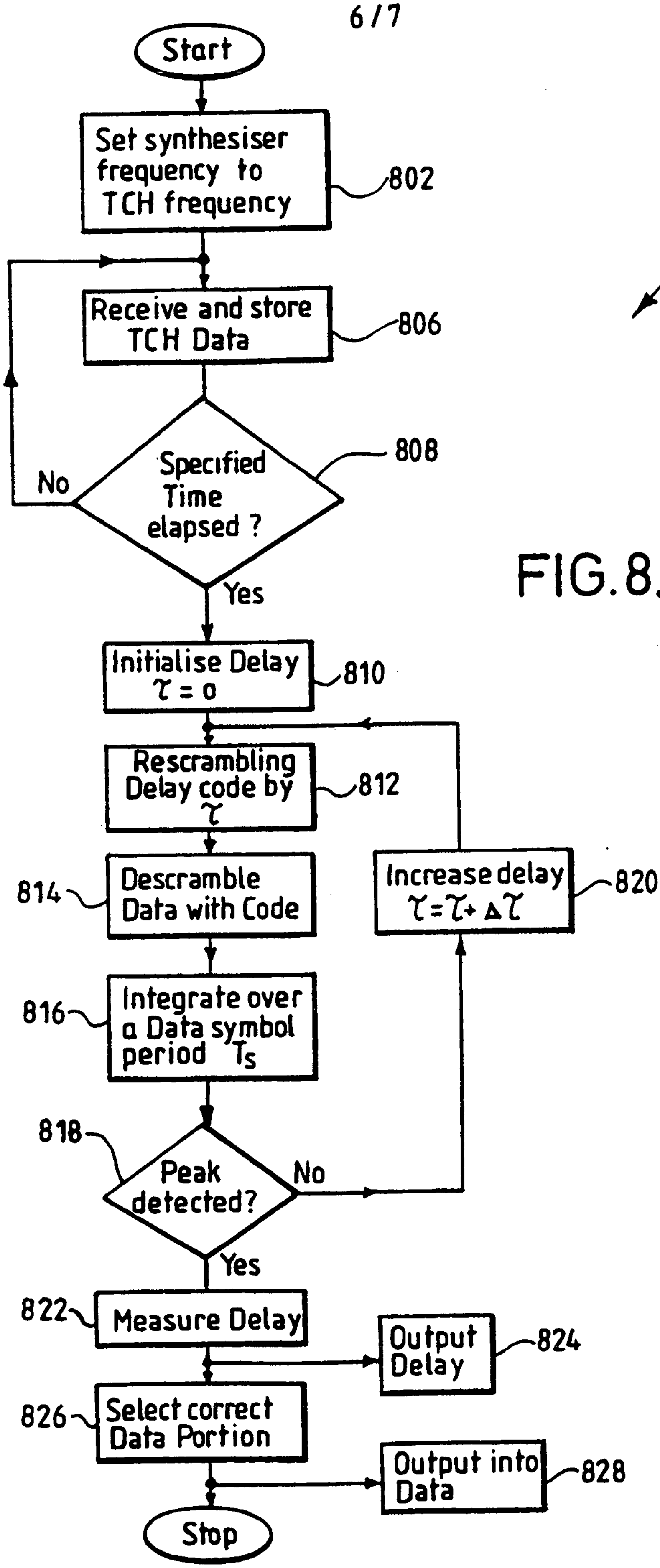
Start
Set synthesiser frequency to TCH frequency
802
800
Receive and store TCH Data
806
Specified Time elapsed ?
808
No
Yes
Initialise Delay $\tau = 0$
810
Rescrambling Delay code by τ
812
814
Descramble Data with Code
Increase delay $\tau = \tau + \Delta\tau$
820
816
Integrate over a Data symbol period T_s
818
Peak detected?
No
Yes
822
Measure Delay
Output Delay
824
826
Select correct Data Portion
Output into Data
828
Stop

FIG. 8.

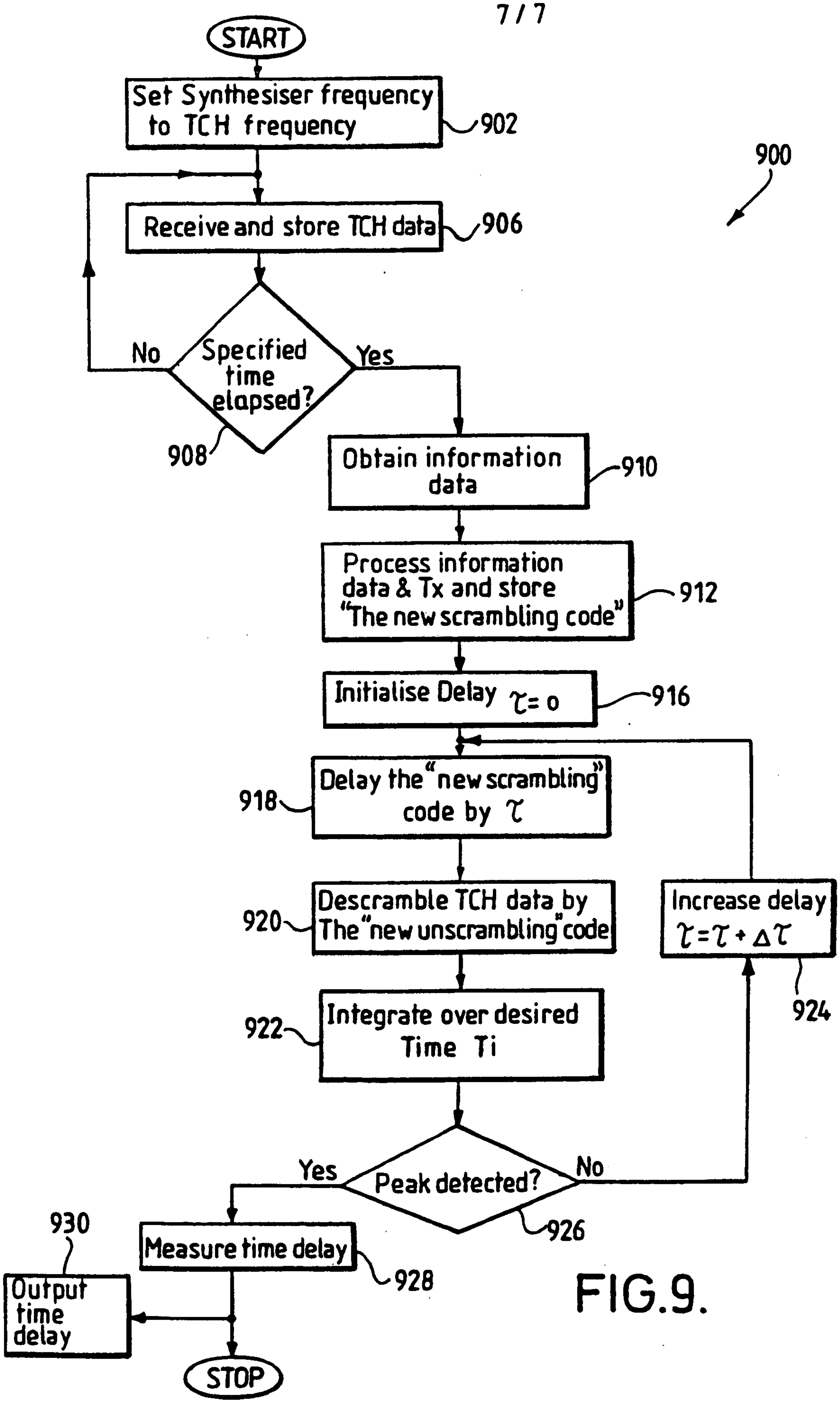
START
Set Synthesiser frequency to TCH frequency
902
900
Receive and store TCH data
906
No
Specified time elapsed?
Yes
908
Obtain information data
910
Process information data & Tx and store "The new scrambling code"
912
Initialise Delay $\tau = 0$
916
Delay the "new scrambling" code by τ
918
Descramble TCH data by The "new unscrambling" code
920
Increase delay $\tau = \tau + \Delta\tau$
924
Integrate over desired Time Ti
922
Yes
Peak detected?
No
926
930
Measure time delay
928
Output time delay
STOP

FIG.9.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/03810

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B7/005 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 440 561 A (WERRONEN ALTON P) 8 August 1995	1,3,8,9, 12,14, 19,20
A	see abstract	2,4-7, 10,11, 13, 15-18, 21,22
	see column 1, line 39 - column 2, line 41 see column 3, line 8 - column 6, line 7 see figures 2,3 --- -/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 1999	27/04/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Cochonneau, O

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/03810

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 44983 A (QUALCOMM INC) 27 November 1997	1,4,8,9, 12,15, 19,20
A	see abstract	2,3,5-7, 10,11, 13, 16-18, 21,22
	see page 5, line 22 - line 34 see page 7, line 37 - page 22, line 10 see page 31, line 28 - page 35, line 24 see figures 1-3,6-9 ---	
X	US 5 267 261 A (BLAKENEY II ROBERT D ET AL) 30 November 1993	1,4,8,9, 12,15, 19,20
A	see abstract	2,3,5-7, 10,11, 13, 16-18, 21,22
	see figures 1,8,9 see column 3, line 26 - column 4, line 43 see column 5, line 10 - column 12, line 22 see column 22, line 15 - column 29, line 53 -----	

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. onal Application No
PCT/GB 98/03810

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5440561 A	08-08-1995	NONE	
WO 9744983 A	27-11-1997	AU 3209197 A	09-12-1997
		EP 0900512 A	10-03-1999
US 5267261 A	30-11-1993	US 5640414 A	17-06-1997